3.0 ENVIRONMENTAL MONITORING PROGRAM - DESCRIPTION AND RESULTS

This report reflects some of the changes in the environmental monitoring network which have been implemented in the past two years to provide an enhanced level of environmental surveillance in anticipation of high-level waste solidification activities. The complete surveillance program as it was implemented in 1984 and will be operated in 1985 (including effluent, on-site, and off-site monitoring) is summarized in tabular form in Appendix A.

The major pathways for off-site movement of radionuclides are by surface water runoff and airborne transport. The environmental monitoring program therefore emphasizes the collection of air and geohydrological samples. The ingestion and assimilation of radionuclides by game animals and fish that include the WNYNSC in their range is another significant potential pathway. In addition to the radiological environmental monitoring program, WVNS participates in the State Pollution Discharge Elimination System (SPDES) and operates under state-issued air and water discharge permits for Nonradiological plant effluents. Section 3.2 summarizes Nonradiological monitoring in 1984 and Appendix C-5 provides greater detail on these activities.

3.1 Radiological Monitoring

Air, water, and selected biological media were sampled and analyzed to meet Department of Energy and plant Technical Specification monitoring requirements. To meet guidelines and provide appropriate reference parameters, a number of other sampling points were added or upgraded in 1984.

3.1.1 Radioactivity in Air

In 1984, airborne particulate radioactivity was sampled continuously by three air samplers at locations shown in Figure 3-1. Each air sampler, mounted on a 4-metre high tower, maintains an average air flow of about 40 litres/min (1.5 ft^3/min) through a 47 mm glass fiber filter. During 1984 another air sampler was added on Rock Springs Road near the closest residence downwind of the plant (Figure 3-1), and additional samplers were located in Great Valley, Springville, and West Valley (Figure 3.2). These four new samplers operate at the same rate as the three mounted on towers, but the sampler head is at 1.7 metres above the ground (the height of the average breathing zone).

The filters were collected weekly and analyzed after a seven-day decay period to remove interference from short-lived naturally occurring radioactivity. Gross alpha and gross beta measurements of each filter were made using a low-background gas proportional counter. The average concentrations ranged from 1.27 E-14 to 2.82 E-14 microcuries per millilitre (uCi/ml) beta, and 6.5 E-16 to 1.68 E-15 uCi/ml alpha activity.

In all cases, the measured activities were below 1 E-12 uCi/ml beta, and 2 E-14 uCi/ml alpha, the most limiting concentration guides listed in DOE Order 5480.1 for releases to uncontrolled areas. (The standards and concentration guides from DOE Order 5480.1 are reproduced as Appendix B. Results of the analyses of perimeter air sample filters are presented in Appendix C-2.) For comparison, the 1982 and 1983 data from the New York State Department of Health indicated a normal background concentration of gross beta activity in air which averaged 2 E-14 uCi/ml in Albany, New York (Huang, 1984). These measurements indicate that site activities have no discernible influence on off-site airborne radioactivity.

At four perimeter locations, three of which coincide with air samplers, fallout is collected in open pots. The data from these collections are presented in Appendix C-2. Because of the low concentrations, the large volume samples from the plant ventilation stack provide the only practical means of determining the amount of specific radionuclides released from the facility. The average monthly concentrations for gross alpha and beta radioactivity released from the stack, based on the 52 weekly filter measurements, are shown in Table C-2.1 of Appendix C-2. The results of analyses for specific radionuclides in the four quarterly composites of stack effluent samples are also listed in Table C-2.1.

A new stack sampling system that meets the current ANSI N13.1 standards for sampling from nuclear facilities was installed in mid-1984. A higher flow rate and multiple nozzles assure a more representative sample for both the long-term sample collection and the on-line monitoring system. The variations in concentrations of airborne radioactivity sampled through the in-stack probe reflect the level of in-cell decontamination activities within the facility. Even at this most concentrated point of airborne effluent release, average concentrations were still below the concentration guides for airborne radioactivity released to an unrestricted area.

3.1.2 Radioactivity in Surface Water and Sediment

Four automatic water samplers collect surface water at points along the site drainage channels. Off-site water samples are collected continuously from Cattaraugus Creek at Felton Bridge just downstream of the confluence with Buttermilk Creek, the major surface drainage from the WNYNSC (Figure 3-1).

The Cattaraugus Creek sampler continuously removes a small volume of water (approximately 400 ml/hr) from the creek; a stream stage-level chart recorder provides a means of flow-weighting the weekly composite based on relative stream depth. Gross alpha, beta, and tritium analyses are performed each week, and a weighted monthly composite is analyzed for Sr-90 and gamma emitting isotopes. A grab sample taken monthly from a background location at Cattaraugus Creek upstream of the Buttermilk Creek confluence is analyzed for gross alpha, beta, and tritium. The most elevated concentrations in samples from Cattaraugus Creek during 1984 show Sr-90 to be less than 2 percent of the concentration guide for unrestricted effluent. Gross alpha and gamma emitting isotopes were so low as to be below the detection limit in Cattaraugus Creek water for 5 of the 12 months represented (Table C-1.6) On the average, however, the concentration of radioactivity in Cattaraugus Creek increases detectably after Buttermilk Creek joins it.

During 1983 three surface water monitoring stations in addition to the Cattaraugus Creek samples were put into service. These samplers currently operate in a time composite mode, collecting a 2.5 ml aliquot every half-hour. At each station the composite samples are collected biweekly, composited monthly, and analyzed for tritium, gross alpha, and gross beta radioactivity. These installations collect water from an upstream background location on Buttermilk Creek (Fox Valley Road) and a downstream location at Thomas Corners Road near the confluence of Cattaraugus Creek (Figure 3-1). The third station is on Franks Creek (also known as Erdman Brook) just upstream of the point where Project site drainage leaves the security area (Figure 3-3). Radiological concentration data from these sample points show that average radioactivity concentrations are generally higher in Buttermilk Creek below the WVDP site than above, presumably because a small amount of activity enters Buttermilk Creek from the site via Franks Creek.

The range of gross beta activity, for example, was 2.5 E-9 to 7.2 E-9 uCi/ml upstream in Buttermilk Creek at Fox Valley, and from 5.9 E-9 to 21.4 E-9 uCi/ml in Buttermilk Creek at Thomas Corners Bridge. Nonradiological water quality measurements taken at the Franks Creek location are discussed in Section 3.2 of this report.

Sediments from Buttermilk Creek and Cattaraugus Creek were analyzed for gamma-emitting isotopes. The results are at levels comparable to past analyses during the Project. Data are presented in Appendix C-1.

The largest single source of radioactivity released to surface waters is the discharge from the Low-Level Waste Treatment (LLWT) system through the Lagoon 3 weir (SPDES 001, see Figure 3-3) and into Erdman Brook. There were six batch releases (a total of about 51 million litres) from Lagoon 3 in 1984. The effluent was grab sampled daily during the 52 days of release and analyzed. The total amounts of activity in the effluent are listed in Table C-1.1. Of the activity released from Lagoon 3, 3.6% of tritium and 7.7% of other radioactivity originated in the New York State disposal area and not from previous or current Project operations. (See Table C-1.11.)

3.1.3 Radioactivity in the Food Chain

Samples of fish and game animals were collected both near and remote from the site during periods when they would normally be taken by sportsmen for consumption. Milk and beef from cows grazing near the site and at remote locations were also collected and analyzed during 1984. The results of these analyses are presented as Appendix C-3.

Fish samples were taken semiannually during 1984 above the Springville dam from the portion of Cattaraugus Creek which receives WNYNSC drainage. Nine fish were collected from this section of the stream during both periods. The Sr-90 content in flesh and skeleton, and gamma emitting isotopes in flesh were determined for each specimen.

Control data are included in this report to permit comparison with the concentrations found in fish taken from site-influenced drainage. For this purpose a number of fish were taken from waters that could not have been influenced by site runoff and the edible portions of them were analyzed in a similar manner; these control (natural background) samples were representative of some of the species collected in Cattaraugus Creek as well as species common in ponds and lakes. The 1984 concentrations of strontium and cesium isotopes in the edible flesh show a slight downward trend compared to 1983 data (WVNS, 1983): the Sr-90 content in the skeleton showed a marked downward trend from previous measurements during recent years (Wilcox and Smokowski, n.d.) The statistical treatment of the fish data presented in Appendix C-3 is specified by the site reporting requirements.

Portions of a single deer from a resident herd on the east side of the WNYNSC were analyzed. The concentration of cesium-137 in deer flesh was considerably higher than the concentration in the previous year's sample, but still within the range seen in samples within the last 5 years. Data from a control, or background, deer sample collected in 1984 from an Allegany County location 80 km from the site are shown for comparison. The concentration of radioactivity in meat from a local beef animal was indistinguishable from the concentration in a control sample.

Although the dairy cattle sampled monthly in 1984 reside adjacent to the site and receive the maximum exposure of any dairy herd, the concentration of Sr-90 in milk ranged only from 1.1 to 2.8 pCi/l. Iodine-129 and gamma emitting isotopes were not detectable. Control milk samples from the Albany, New York area, provided under a cooperative agreement by the New York State Department of Health laboratory and analyzed by WVDP, showed a concentration of 2.9 pCi/l of Sr-90 in 1984.

In Section 4 of this report, radionuclides present in the human food chain are discussed and their contribution to the radiation exposure of the public is assessed. Although in many cases the concentrations of specific radionuclides were below the analytical detection limit, for purposes of the dose assessment they were considered present at the minimum detectable concentration. Although the maximum concentrations of radioactivity found in some biological samples were above background levels, the dose associated with consumption of these samples would be far below the protection standards.

3.1.4 Direct Environmental Radiation

1984 was the first complete year in which direct environmental radiation monitoring at WVDP relied solely on TL-700 LiF dosimetry. The uncertainty of individual results and averages were acceptable and measurements were more precise than in 1983. There were no significant differences between the background TLDs and those on the site perimeter.

In 1984, four new TLD locations were added to the program: one at the Rock Springs Road air sampler (AFRSPRD), one in Great Valley (AFGRVAL), one in Springville (AFSPRVL), and one in West Valley (AFWEVAL). The Great Valley site will serve as a second background location.

Dosimeters used to measure ambient penetrating radiation during 1984 were processed on-site. The system uses Harshaw TL-700 lithium fluoride Thermoluminescent Dosimetry (TLD) materials which are maintained apart from the occupational dosimetry TLDs as a select group for environmental monitoring. The environmental TLD package consists of five TL chips laminated in a thick card bearing the I.D. and other information. These cards are placed at each monitoring location for one calendar quarter (3 months) and then processed on-site to obtain the integrated gamma radiation dose.

Monitoring points are located around the site perimeter, at the waste disposal area, and at background locations remote from the WVDP site. Appendix C-4 provides a summary of the results for each location by quarter along with averages for comparison.

The quarterly averages and individual location results show differences due to seasonal variation in snow cover. During the first quarter (January through March) of 1984 the average quarterly exposure (0.0119 roentgen) decreased due to snow cover. The second quarter (April to June) average was also low (0.0111 R) due to snow cover and heavy rains. The third quarter of 1984 (July to September), with no snow cover and low rainfall, had the highest quarterly average (0.0162 R). Moderate rainfall and snow cover in the fourth quarter (October to December) decreased the quarterly average to 0.0132 R.

This short-term (1 year) evaluation indicates that seasonal variation due to rainfall and snow cover has a significant effect on ambient penetrating radiation measurements around the WVDP site.

Presumably, because of their proximity to the disposal area, two locations near the waste burial area (18 and 19 on Figure 3-1) showed a small increase in radiation exposure compared to the perimeter locations.

3.2 Nonradiological Monitoring

West Valley Demonstration Project nonradioactive effluents are regulated by the New York State Department of Environmental Conservation (NYSDEC). Air discharges are insignificant at present and monitoring is not required. Liquid effluents are monitored as a requirement of the State Pollution Discharge Elimination System (SPDES) permit issued and enforced by NYSDEC.

The WVDP SPDES permit identifies six locations where monitoring is required. They are shown in Figure 3-4 and described in Table C-5.1 of Appendix C-5, which also provides further information on the items discussed below.

During 1984 there were 18 instances of noncompliance with discharge limits. Of these, seven are related to iron concentrations in Erdman Brook, six are associated with operation of the sewage treatment plant, two are attributed to sampling or analytical error, two lead excursions at Lagoon 3 (point 001) are being investigated and a pH excursion at point 001 was caused by excess caustic from the low-level waste treatment facility.

The iron excursions in Erdman Brook (measured at point 006) were caused by accumulation of particulate iron on the raw water clarifier which subsequently was backflushed to Erdman Brook where ambient iron concentrations are very near the permit limit of 1.0 milligram per litre (mg/l). Consolidation of this outfall with outfall 004 into a flow equalization basin should alleviate the problem of slug flow discharge of iron to Erdman Brook. This is planned for implementation in 1985.

The sewage treatment plant which is operating beyond its design capacity was the location of excursions beyond permit limits for BOD-5 and pH. A larger capacity treatment plant is being installed and should eliminate the compliance problems at this location.

The environmental impacts associated with these noncompliance episodes are negligible because of their small magnitude and short duration, the chemical nature of the noncomplying parameters, and natural dilution by a factor of approximately 1,000 between SPDES 006 and Cattaraugus Creek at the site boundary (the nearest point of public access).

3.2.1 Pollution Abatement Projects

The WVDP began construction of a new sewage treatment plant during 1984. This plant represents an improved method of sewage treatment compared to the existing facility and provides adequate capacity for the projected total work force at the project.

The plant consists of a grinder station where raw sewage is received, mixed, and transported via a force main to a multichambered extended aeration plant. This plant provides biological treatment (secondary treatment) of the sewage to reduce BOD and includes sludge settling and return capabilities as well as sludge washing (removal) capability. Following aeration and biological treatment, the effluent is disinfected by chlorination before discharge.

The sewage plant initially will discharge to Erdman Brook via existing SPDES outfall 004. Eventually it will discharge to a flow equalization basin where the flow will be mixed with other nonradioactive liquid effluents before being discharged to Erdman Brook via a new SPDES outfall.

Utilization of the sewage plant and the flow equalization basin is expected to reduce dramatically the number of SPDES noncompliance episodes at the WVDP.

3.3 Groundwater Monitoring

3.3.1 Hydrology of the Site

The WVDP site lies within the Glaciated Allegheny Plateau section of the Appalachian Plateau Physiographic Province. The section is a maturely dissected plateau with surficial bedrock units of Devonian shales and sandstones. Bedding dips gently (4 to 7.5 metres per km) and uniformly to the south. The plateau has been subjected to the erosional and depositional actions of repeated glaciations, resulting in accumulation of till, outwash, and lacustrine deposits over the area.

The hydrogeology of the WVDP site has been and continues to be extensively investigated. The following paragraphs provide a simplified but accurate synopsis of the site geology and the pathways for radionuclide migration through this geologic system.

The WVDP site is underlain by a thick sequence of silty clay tills and more granular deposits overlying a bedrock valley that has been carved through Devonian shales by Cattaraugus Creek and its tributaries. Figure 3-5 shows a generalized east-west cross section through the site. The uppermost till unit is the Lavery, a very compact gray silty clay. The Lavery is approximately 6 m thick at the western boundary of the WVDP and thickens to the east. At the western edge of the developed portion of the WVDP, the Lavery is approximately 30 m thick. In situ measurements of the hydraulic conductivity in the Lavery have generally ranged between 10^{-9} and 10^{-7} cm/sec.

The upper 3 m (approximately) of the Lavery have been chemically weathered by leaching and oxidation and mechanically weathered by bioturbation. The hydraulic conductivity of the weathered till is much higher that of than the underlying unweathered parent material, probably as a result of increased fracture flow.

The northern portion of the WVDP site is blanketed by a layer of alluvial gravels up to 6 m thick. These gravels extend from the plant area northward; they are not encountered in the disposal areas in the southern part of the WVDP site.

Below the Lavery till is a more granular unit. Referred to locally as the Lacustrine Unit, it comprises silts, sands and, in some areas, gravels which overlie a varved clay. The Lacustrine is believed to be more permeable than the Lavery, but little permeability testing has been performed in this unit. Prior modelers of site hydrogeology have generally assumed hydraulic conductivities on the order of 10^{-5} to 10^{-4} cm/sec-- conservative in consideration of the gradation of the Lacustrine Unit materials.

Free field groundwater flow through the described geosystem occurs in two aquifers and to a considerably lesser extent in the aquaclude between them. The upper aquifer is a transient water table aquifer in the weathered till and, where it is encountered, the alluvial gravels. To a lesser extent, the highly fractured upper metre of the unweathered till is also part of this aquifer. This unit is generally unsaturated, but immediately after periods of intensive runoff, such as a spring thaw, significant quantities of groundwater are believed to flow through this unit. The primary flow occurs through the extensive system of fractures which dissects this unit.

The lower aquifer is an unconfined aquifer in the Lacustrine Unit. The piezometers embedded in this unit all exhibit phreatic heads below the top of this unit. The total recharge mechanism for the unit is not well defined because of a paucity of data, but it is reasonable to conclude from available data that the unit is recharged from the fractured bedrock and downward seepage through the overlying Lavery till. The bedrock recharge zone to the west is recharged at outcrops in the uplands to the west of the site. Flow through this unit appears to be to the east toward Buttermilk Creek.

The aquaclude that separates these two aquifers is the Lavery. Its mass permeability is extremely low but it does permit seepage. When the weathered till is acting as a transient aquifer, a vertical gradient of unity exits in the till and causes water to move downward, but at a very low rate.

The USGS and NYSGS have performed extensive hydrogeologic investigations in and around the area once used by NFS for solid waste disposals and now contemplated as a potential site for disposal of Project wastes. All of these studies assumed that the groundwater pathway from the disposal trenches was one-dimensional downward seepage through the unweathered till. This was based on observations of water levels in well screen piezometers and some simplifying assumptions. No measurements were made to characterize unsaturated flow in the weathered till.

The observation of solvent in the shallow weathered till some 60 ft (18 m) away from its point of disposal casts considerable doubt on some of the assumptions which neglected flow in the unsaturated zone. Therefore, as part of the preparation of the Environmental Assessment for low-level waste disposal, WVNS has implemented extensive explorations and an instrumentation network to characterize and monitor flow in the unsaturated weathered till. Because data from the solvent seepage explorations indicated rapid fluctuations in the level of the transient perched water table, the instrumentation network uses real-time data loggers that record water levels at hourly intervals.

The hypothesis of one-dimensional downward flow is also being tested as part of this exploration program. The well screen piezometers all have significant time lags. (For example if the piezometric level rose one foot, it might take more than a year before the rise was evident in a well screen piezometer. This could mask a lateral flow component, particularly a transient one.) WVNS has therefore installed pneumatic pore pressure transducers which have a time lag of less than one minute.

The results of this investigation will be reported in the Environmental Assessment scheduled to be published in August, 1985.

3.3.2 Groundwater Monitoring in 1984

A program of sampling groundwater both on the Project site as well as from wells at residences around its perimeter was carried out in 1984. The shallow wells in this program fall into four groups:

1. A group of dug shallow wells installed north of and immediately surrounding the main plant building were monitored for several years before Project start-up and are therefore used for reference to examine long-term trends.

2. The U.S. Geological Survey (USGS) series 80 wells form an outer ring around the facility dug wells.

3. The USGS series 82 wells are grouped around the formerly-licensed disposal area.

4. Private wells around the perimeter are used for drinking water by site neighbors.

Appendix A gives more information on sampling requirements, and Appendix C-1 summarizes results of the radiological analyses of samples from the wells. Except for those on-site wells that historically show localized contamination, there was no indication of fuel-cycle isotopes in these wells.

3.4 Special Monitoring

In November of 1983, contamination was encountered in a recently drilled USGS series 82 ground water monitoring well near the formerly licensed NFS solid radioactive waste disposal area. In the samples analyzed, the organic contaminant contained concentrations of alpha emitters on the order of 10^{-5} uCi/ml and beta/gamma emitters at about 10^{-4} uCi/ml. This led to an extensive examination of ground and surface water near that location. Samples were collected from closely spaced sampling wells and surface streams adjacent to the suspect area. Although subsequent evaluations and test borings did confirm the subsurface presence of a contaminated organic fluid, monitoring of surface water and wells adjacent to surface waters failed to show any transport away from the immediate vicinity of the disposal area. In 1984, monitoring of all downstream points (including more frequent sampling of drainage water immediately below the suspect area) indicated no detectable increase in radioactive contaminants. A decontamination effort was initiated in 1984 to remove the fluid from within the disposal area; continued monitoring of adjacent groundwater has shown no further migration from the original area. The USNRC, the agency under whose jurisdiction the solvent was disposed of, has contracted with Oak Ridge National Laboratory to review the solvent transport phenomena and to develop plans for further investigation and remediation.

During the summer and fall of 1984, a comprehensive aerial survey of the WNYNSC including the West Valley Demonstration Project site was performed by EG&G under DOE sponsorship. Measurements utilized not only state-of-the-art gamma radiation instruments but also high resolution photography and multi-spectral scanning data. The final report is in preparation by EG&G and careful attention is being given to comparison with previously acquired data from the same area.

LOCATIONS OF PERIMETER ENVIRONMENTAL MONITORING STATIONS

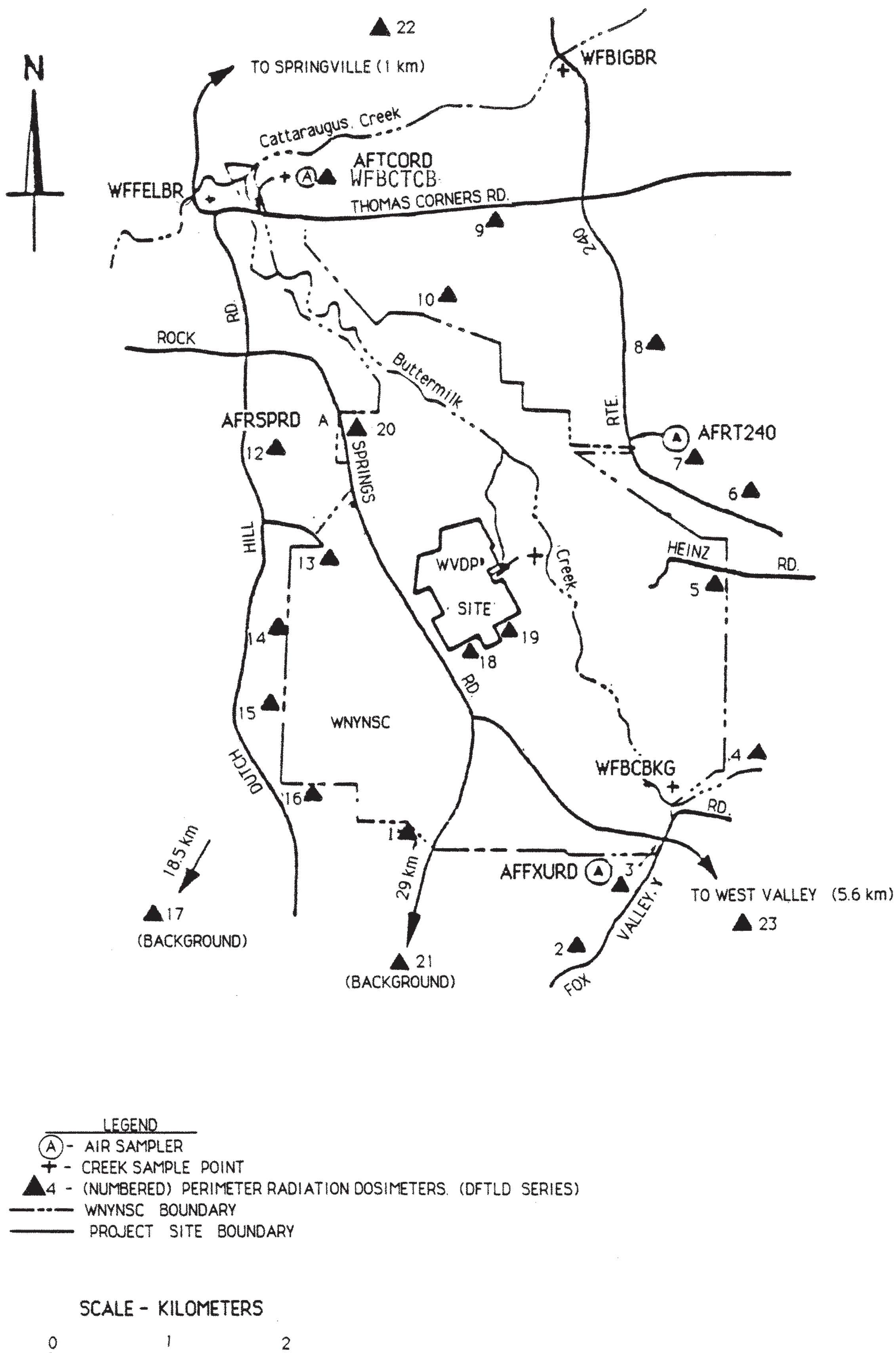


FIGURE 3-1

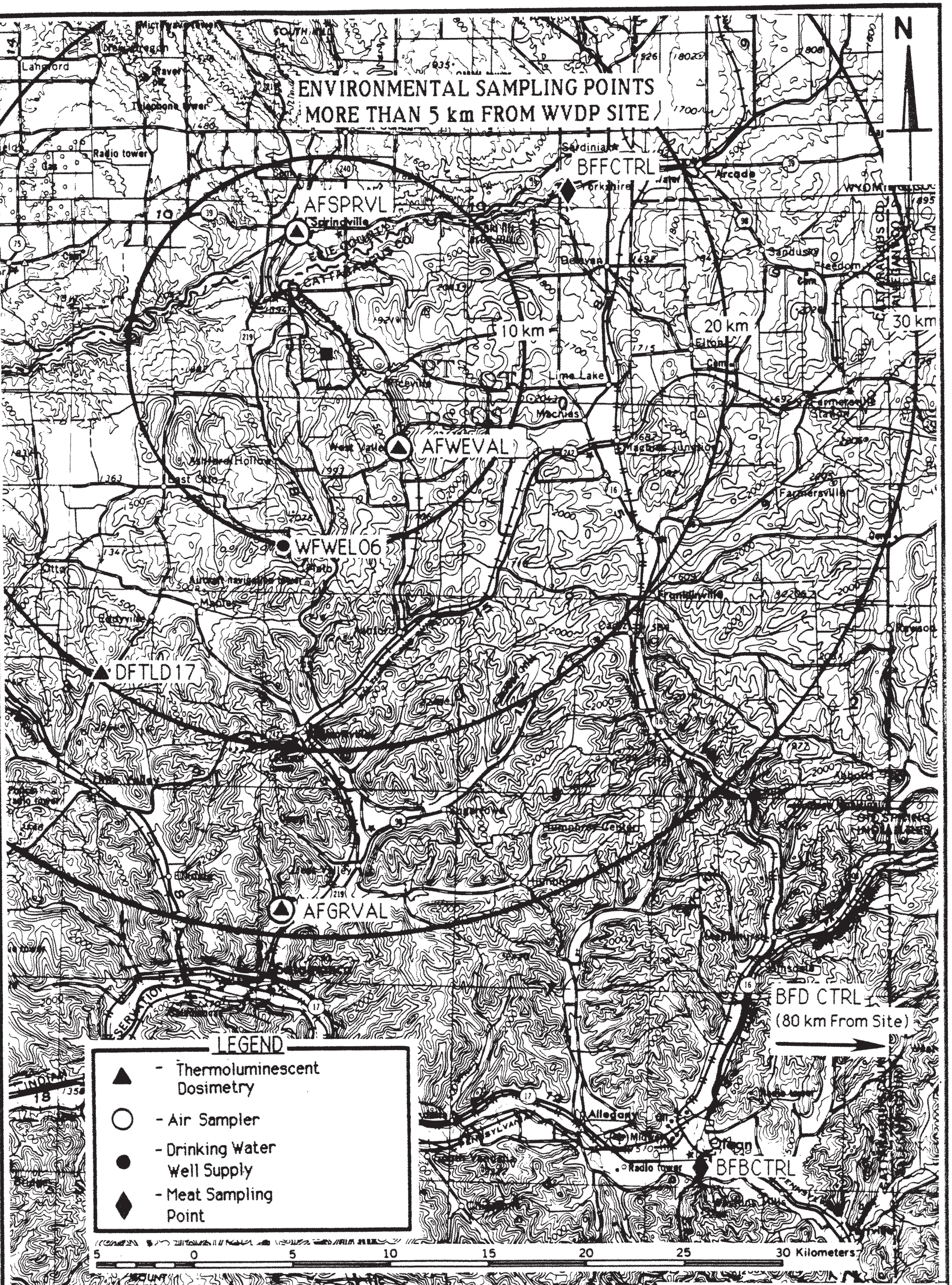

ENVIRONMENTAL SAMPLING POINTS
MORE THAN 5 km FROM WVDP SITE
N
BFFCTRL
AFSPRVL
10 km
20 km
30 km
AFWEVAL
WFWEL06
DFTLD17
AFGRVAL
BFD CTRL
(80 km From Site)
BFBCTRL
LEGEND
- Thermoluminescent Dosimetry
- Air Sampler
- Drinking Water Well Supply
- Meat Sampling Point
5 0 5 10 15 20 25 30 Kilometers

FIGURE 3-2

LOCATION OF EFFLUENT RADIOLOGICAL MONITORING POINTS ONSITE

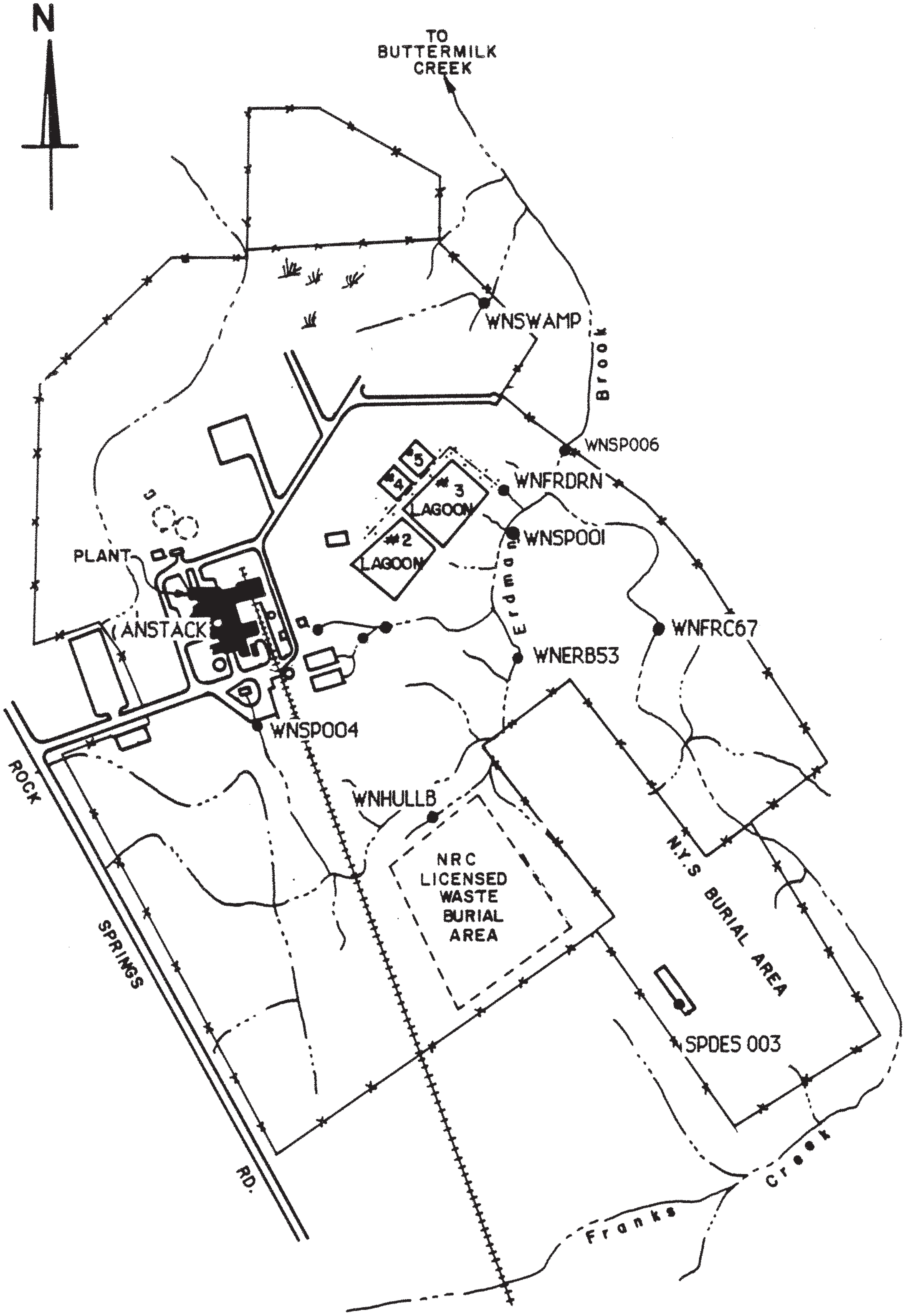
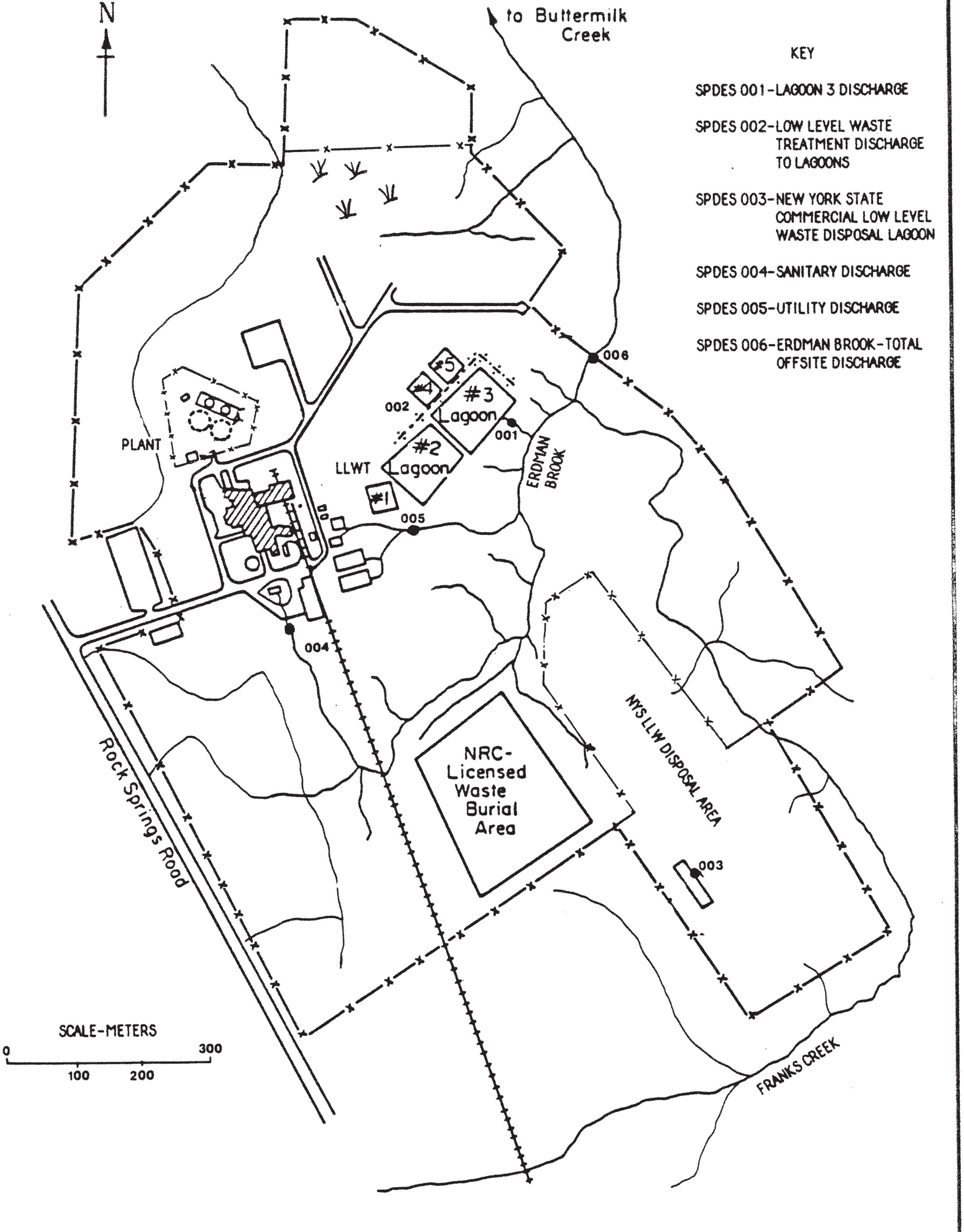
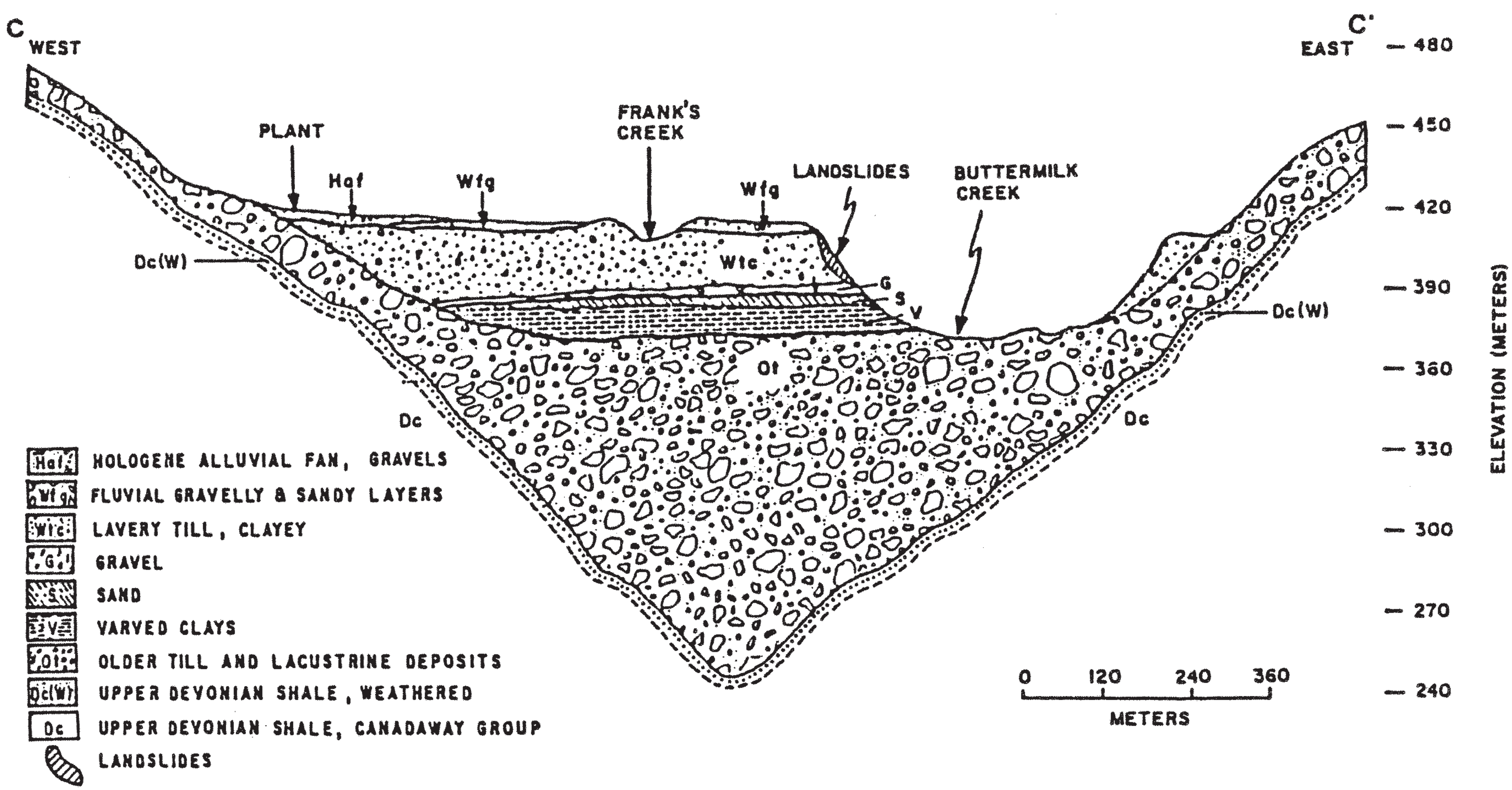


FIGURE 3-3



LOCATIONS OF SPDES MONITORING POINTS ONSITE

FIGURE 3-4



NOTE:
Vertical scale = 1/4 horizontal scale.
Adapted from Dana et al. (1979a).

GENERALIZED EAST-WEST GEOLOGIC CROSS SECTION AT THE WEST VALLEY DEMONSTRATION PROJECT

FIGURE 3-5